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Gannet Electronics

Every weapon of war is designed and built primarily for a specific purpose. The Fairey Gannet's primary purpose was submarine detection, and to achieve this, the aircraft was fitted with two special electronic devices. One was the **ASV Mark 19b** ten centimetre radar, and the other was a combination of *sonobuoy transmitters which were dropped into the sea in the vicinity of a suspected submarine, and a custom built receiver fitted in the Gannet. Without these devices, the Gannet was simply another carrier borne general purpose aircraft. The following descriptions give a brief summery of the equipment used.

**Sonobuoy ... a device used to detect acoustic waves, such as those produced by ships and submarines, when activated would relay information by radio. These signals can be active or passive, and could be either directional or non-directional*

ARI (Air Radio Installation) and its subsequent four-digit number were used to identify the collection of devices fitted to a particular model or version of an aircraft. For example ARI 5284 was the radio altimeter.

HF (High Frequency) represented the frequency range of HF equipment, and was typically from 2,000 to 15,000 Kilocycles, or in more recent terminology KiloHertz (KHz). Depending upon a number of factors such as the time of day or night, the aircraft's altitude and its orientation, the power of the aircraft's and the shore based transmitter, the sensitivity of the receivers to name some, the effective range of voice transmission could be anything between 20, and 400 miles. During Morse code operation (see MCW), the effective range could be as far as 4,000 miles.

VHF (Very High Frequency) typically from 100,000 to 150,000 KHz (100 to 156 Megahertz). Unlike HF transmission and reception, VHF was "line of sight". This means that, assuming the eyesight distance capability of Superman, if the communicating transmitters and receivers could "see" each other, then voice communication could take place. So an aircraft at an altitude of 20,000 feet 50 miles distant could communicate with a ship, but at 100 feet 20 miles distant could not communicate, because of the blanking effect of the earth's curvature.

RT (Radio Telephony), is the transmission and reception of voice modulated radio waves, for example commercial radio broadcasting on MCW (Modulated Continuous Wave). .

MCW (Modulated Continuous Wave) is the carrier frequency, as an example, at 6,000 KiloHertz it would be modulated at an audible frequency of say 1,200 Hertz. This continuous signal would then be interrupted by the Observer, using his Morse key to send Morse code information, which when demodulated by the receiver would sound as a series of 'beeps' at 1200 cycles per second.

Hertz or Cycles is the frequency of radio and sound waves quantified using the term Hertz, which is the modern term for cycles. If an electrical current flows in one direction from zero through maximum then back to zero, then again in the reverse direction from zero through maximum back to zero, it is said to be an alternating current. Where it completes this total cycle in a given time the frequency of that alternating current can be determined. So the mains current and voltage to our homes is 50 cycles per second, or 50 Hertz. HF radio transmission is typically 2 to 15 thousand kilocycles cycles per second (2 to 15 Megacycles), and VHF is typically 100,000 to 150,000 Kilocycles per second (100 to 150 Megacycles).

Wavelength. There is a constant relationship between the frequency of a radio transmission and the length of the radio wave, the higher the frequency, the shorter the wavelength. The constant in this relationship is the velocity of radio transmission, which allowing for minor variations due to influencing factors such as temperature and media such as dry air or moist air, is 3 X 108 metres per second. Thus the wavelength of a VHF transmission at 150 MegaHertz is 2 metres.

Centimetric Radar is the operating frequency of the ASV Mark 19b radar unit was at a nominal 3,000 MegaHertz. Using the formula described in Wavelength above, the wavelength of the radar transmissions was 10 centimetres, hence the term centimetric radar.

Tx/Rx. Abbreviations to indicate transmitter/receiver.

PPI (Plan Position Indicator0 is a circular display radar screen on which the echo of a target is displayed at a bearing (relative to the aircraft or ship's heading), and at a distance from the aircraft or ship IFF.

IFF (Identification Friend of Foe), an automatic device which would indicate if the target being approached was one of ours or one of theirs.

‘g’ &’ gs’ . Acceleration of a body due to the effect of gravity is measured and expressed as "g". One g is and acceleration of 32 feet per second per second. This means that under free fall conditions, a body will fall 32 feet in the first second, and 64 feet in the second second, and so on until a terminal velocity (it can't go any faster) is reached.

SPECIAL ELECTRONICS

ASV Mark 19b Centimetric Radar. This was designed to locate submarines and above surface projections such as a periscope or snorkel. The radar TxRx and the scanning antenna were mounted under the aircraft's fuselage behind a Perspex dome or nacelle, typically called the radome. When the equipment was brought to operation, the Observer in the center cockpit would actuate the lowering mechanism and the whole radar assembly would be lowered about I metre below the fuselage allowing a full 360 degrees unobstructed aerial scan of the sea and terrain below. The Observer had control of the antenna in that he could sector the sweep instead of allowing a full 360 degrees continuous rotation, and he could orient the antenna in elevation, within limits, to facilitate coverage regardless of the aircraft's altitude. The centre Observer had a control panel, which allowed him to select for operation any of VHF, HF, Sonobuoy, crew intercom exclusive, or ZBX.

ARI 5286 Sonobuoy Receiver. Early sonobuoys were cylindrical shaped non directional transmitting devices, each with its own transmitting frequency. They would be dropped in a prescribed pattern, directed to remain in a somewhat vertical orientaion during descent by a small parachute. Upon hitting the water the impact would operate a release catch. This catch would release the hydrophone from the bottom of the cylinder to sink into the sea below the floating sonobuoy until the connecting cable stopped the descent at about 50 feet. Knowing the frequencies of the

dropped sonobuoys, and the dropped pattern, the Observer could listen to the various signals coming from the buoys to his receiver, and could make a reasoned judgment about the location and movement of a submarine relative to the buoy pattern.

These cylindrically shaped sonobuoys were about 12 centimetres in diameter and perhaps 80 centimetres long. Prior to take off, these sonobuoys were fitted to the aircraft's bomb racks by the Armourers, who had to ensure that the telescopic aerials were extended. The Observer would select which buoys would be dropped, but the dropping command would be executed by the Pilot via switch on the control column. The frequency range of the equipment was 62.9 to 71.7 Megacycles. The duration of the transmitted signal depended upon the state of charge in the batteries inside the sonobuoy, and could be anything up to 4 hours. Depending upon the noise being made by a submarine, effective range was between one half and three miles. The sonobuoy receiver was located in the centre cockpit. The receiver aerial was located …… ???. Typically each Gannet could carry up to 12 sonobuoys, thus enabling each aircraft to carry out 2 searches using 6 sonobuoys on each search.

An improved sonobuoy was later introduced. This was a directional sonobuoy about 3 times the size of the non directional units. These in turn were later replaced by the dunking sonar. An analogy of this latter was like dunking your toe into the water a number of times at different places until you found the lost pieces of eight.

As an aid to locating each dropped buoy, a bag of dye was fixed to the cylinder such that when in contact with the sea water a fluorescent patch would spread around the buoy on the surface of the water. These latter buoys also had a water soluble plug which after being immersed for about 2 hours would dissolve allowing sea water to enter the cylinder thus causing the buoy to sink.

As well, Fairey Gannets had other electronics within the categories of communications, navigaional aids and security identification were as follows:

COMMUNICATIONS

ARI ZZZ, HF **TxRx** Transmission & reseption by Oberver operated morse code. Alternatively RT communication also under control of an Observer.Typical frequency used was 4 to 8 Megahertz. The control unit was located in theJ388) & the TxRx was located in the ……????? The antenna was a length of copper wire strung from a post projecting upwards about 80 centimetres from the fuselage behind the pilot's head, longitudinally across the upper fuselage to a fixed point on the leading edge of the tail fin. Mid way along this wire another wire was taken to the second Observer's cockpit as the TxRx feed to/from the aerial.

ARI 5488 through 5492, VHF TxRx. Control panel was in the Pilot's cockpit. The TxRx was crystal locked to 10 preselected frequencies. All the Pilot had to do to change operating frequency was to turn a knob. This equipment was also the device for crew voice communication to each other. The 5 different ARIs were for 5 different combinations of TxRx. One such was ARI 5490 which comprised two TxRx, the TR 1934 and the TR 1935. The frequency range of TR 1934 was 100 to 125 Mcs, and that of the TR 1935 was 124.5 to 156 Mcs. Also fitted was an automatic relay unit, which allowed the aircraft to receive a base transmission at say 120 Mcs on the TR 1934, and to retransmit this automatically at say 140 Mcs on the TR1935. Thus the effective operating VHF communication range was doubled. Maximum range aircraft to base was 200 miles at 10,000 feet. Considering the aerial power output was no more than 3.5 watts, this is rather remarkable. The aerial was a quarter wave dipole (cut to a length of 60 centimetres), a fixed stiff wire radio aerial suitable for both transmission and reception. This aerial was mounted ……??????

NAVIGATIONAL AIDS

ARI 5307. ZBX Receiver. This little receiver had a non directional aerial, but it received signals from a transmitter, with a directional aerial. For ease of explanation, assume the ground installation (as opposed to the shipboard installation), and assume that the transmitter sent out signals in only eight sectors of the compass. The ground transmitting equipment had a continuously rotating directional aerial, making one complete revolution every minute. When transmitting in the north to north east sector, it would transmit morse code for the letter A twice in succession. In the north east to east sector it would transmit the letter B twice. In the east to south east sector it would transmit the letter C, and so on. Thus if the Observer listened in on his ZBX receiver and heard the letter B at full strength, and the letters A and C at low strength, and no other letters being received, it would be clear that to steer a course towards the transmitting station the aircraft would need to head in a south westerly direction. The

receiver was fitted in ..... ??? and its quarter wave dipole aerial was located ..... ???

ARI 5284. AYF **Radio** Altimeter. This device operated on much the same principle as that of radar, in that it sent out a radio signal which hit the terrain below and echoed back to be received by the companion receiver. The frequency of the transmitted signals was continuously changing, (frequency modulated carrier at 120 cps), so that when the echo came back to the receiver its frequency was different from that of the transmitted signal at that instant. Knowing the speed of transmission of radio waves the frequency difference was then used to calculate the vertical height of the aircraft. These calculations were done within the equipment and displayed on an indicator mounted on the panel for the Pilot to read off directly. There were two ranges of operation. Low range was to 400 feet at operating frequencies 420 to 460 Mcs. High range was to 4,000 feet at operating frequencies of 442 to 460 Mcs.

This capability was also useful when a submarine was located on those occasions when the target was not directly under the aircraft. Knowing the slant distance from the AS Mkl9b aerial to the target and knowing the vertical height above the sea level, it became a straightforward matter to calculate the azimuth distance from immediately below the aircraft to the target, useful in directing a surface vessel to attack the target.

The **TxRx** was located in .....??? The Altitude Indicator and the Altitude Limit Indicator Switch were mounted on the Pilot's control panel. There were two aerials, each rather like an inverted "T", the cross bar being about 20 centimeters long. These were fixed to the underside of the mainplane.

SECURITY IDENTIFICATION

ARI 5848. AN/APXII, IFF (Phonetically read this as "Ay En Ay Pee Ex 2 I Ef Ef). IFF stands for Identification Friend or Foe. This equipment operated without operator intervention, other than switching it on. The device comprised two units, a Responder and a Transponder. With the Responder switched on, the aircraft could be interrogated electronically, without the crew's knowledge, and the Responder would give an automatic signal back to the interrogator that it was a friendly aircraft. The Transponder had the same capability as that of an external interrogator in that it could interrogate another aircraft to determine if it were a friend or a foe. The responding IFF signal would be displayed on the interrogating aircraft's radar screen. For obvious reasons the identifying coding was changed by prearrangement frequently. Control was

in the hands of the Pilot via a controller on his starboard console. The aerials were located ……. ???

Some Observations

Much of this electronic equipment had been developed in the late 1940s and early 1950s, at a time when the transistor was little more than an experimental laboratory phenomonen. The concept of the transistor was not new in that solid state diodes were in common use during WW2 as a means of converting alternating current to a pulsed current which when "smoothed" became direct current. But in the period we are addressing, all electronic signals were amplified by thermionic valves. If you imagine a present day electric light bulb housed in a box, and you drop that box frequently, and shake it fairly roughly 20 times a day, it wont last long. Thermionic valves in carrier borne aircraft electronic equipment suffered this sort of treatment with repeated catapult launches and deck landings, and the wonder is that much of the equipment continued operational for as long as it did.

Transistors can withstand impact gs and centrifugal gs of up to 20,000. So once transistors became used, and the later development of integrated circuits, electronic equipment reliability was hugely enhanced.

Weight and power consumption were other matters for the aircraft designer to contend with. Compared with thermionic valves, the weight and power consumption of transistors were dramatically less than those of thermionic valves. So with the introduction of transistor based equipment in aircraft which superceded the Gannet, the performance charateristics of all airborne electronics increased hugely.